Claims

1. A method for the heat treatment of in particular sulfidic ores, in which solids are treated at a temperature of 450 to approximately 1500°C in a fluidized bed reactor (1), **characterized in that** a first gas or gas mixture is introduced from below through a preferably central gas supply tube (3) into a mixing chamber (7) of the reactor (1), the gas supply tube (3) being at least partly surrounded by a stationary annular fluidized bed (35) which is fluidized by supplying fluidizing gas, and that the gas velocities of the first gas or gas mixture as well as of the fluidizing gas for the annular fluidized bed (35) are adjusted such that the particle Froude numbers in the gas supply tube (3) are between 1 and 100, in the annular fluidized bed (35) between 0.02 and 2 and in the mixing chamber (7) between 0.3 and 30.

2. The method as claimed in claim 1, **characterized in that** the reactor (1) is provided downstream with a second reactor (9), into which a gas mixture laden with solids is introduced from the first reactor (1) from below through a preferably central gas supply tube (10) into a mixing chamber (19), the gas supply tube (10) being surrounded at least partly by a stationary annular fluidized bed (36) which is fluidized by supplying fluidizing gas.

3. The method as claimed in claim 1 or 2, **characterized in that** the particle Froude number in the gas supply tube (3, 10) is between 1.15 and 20, in particular between 3.95 and 11.6.

4. The method as claimed in any of the preceding claims, **characterized in that** the particle Froude number in the annular fluidized bed (35, 36) is between 0.11 and 1.15, in particular between 0.11 and 0.52.

5. The method as claimed in any of the preceding claims, **characterized in that** the particle Froude number in the mixing chamber (7, 19) is between 0.37 and 3.7, in particular between 0.53 and 1.32.

6. The method as claimed in any of the preceding claims, **characterized in that** the bed height of solids in each reactor (1, 9) is adjusted such that the annular fluidized bed (35, 36) extends beyond the upper orifice end of the gas supply tube (3, 10) and that solids are constantly introduced into the first gas or gas mixture and entrained by the gas stream to the mixing chamber (7, 19) located above the orifice region of the gas supply tube (3, 10).

7. The method as claimed in any of the preceding claims, **characterized in that** a sulfidic ore, which contains gold, zinc, silver, copper, nickel and/or iron, is used as the starting material.

8. The method as claimed in any of the preceding claims, **characterized in that** at least one reactor (1, 9) is supplied with oxygen-containing gas, for example air with an oxygen content of approximately 20 vol-% through the gas supply tube (3, 10) and/or into the annular fluidized bed (35, 36).

9. The method as claimed in any of the preceding claims, **characterized in that** heat is supplied to or extracted from at least one reactor (1, 9) in the annular fluidized bed (35, 36) and/or in the mixing chamber (7, 19).

10. The method as claimed in any of the preceding claims, **characterized in that** provided downstream of at least one reactor (1, 9) is a cooling device (20, 21), in which a solids-laden gas mixture from the reactor (1, 9) is cooled to a temperature of below 400°C, in particular to approximately 380°C.

11. The method as claimed in any of the preceding claims, **characterized in that** provided downstream of at least one reactor (1, 9) is a separator, for example a cyclone (33), from which solids separated from exhaust gases are supplied to the first and/or second reactor (1, 9) or to a further cooling device (26).

12. The method as claimed in claim 11, **characterized in that** at least part of the exhaust gases separated from the solids in the separator (23) is supplied to the first and/or the second reactor (1, 9) as fluidizing gas, in particular after treatment in a downstream gas cleaning stage, such as a hot-gas electrostatic precipitator (31) and/or a wet-gas treatment (32).

13. The method as claimed in claim 11 or 12, **characterized in that** at least part of the exhaust gases separated from the solids in the separator (23) is supplied to a plant (33) for producing sulfuric acid.

14. The method as claimed in any of the preceding claims, **characterized in that** coarse-grained solids and/or roasting residue are drawn off, in particular discontinuously, from the annular fluidized bed (35, 36) of the first and/or second reactor (1, 9) and passed on to a further cooling device (26).

15. A plant for the heat treatment of in particular sulfidic ores, in particular for performing a method as claimed in any of claims 1 to 14, comprising a reactor (1) constituting a fluidized bed reactor, **characterized in that** the reactor (1) has a gas supply system which is formed such that gas flowing through the gas supply system entrains solids from a stationary annular fluidized bed (35), which at least partly surrounds the gas supply system, into the mixing chamber (7).

16. The plant as claimed in claim 15, **characterized in that** the gas supply system has at least one gas supply tube (3) extending upwards substantially vertically from the lower region of the reactor (1) into a mixing chamber (7) of

the reactor (1), the gas supply tube (3) being at least partly surrounded by an annular chamber in which the stationary annular fluidized bed (35) is formed.

17. The plant as claimed in claim 16, **characterized in that** the reactor (1) is provided downstream with a second reactor (9), which has a gas supply tube (10), which is connected to a discharge conduit (8) for solids-laden gas mixtures provided at the upper end of the first reactor (1) and is formed such that gas flowing through the gas supply tube (10) entrains solids from a stationary annular fluidized bed (36), which at least partly surrounds the gas supply tube (10), into the mixing chamber (19).

18. The plant as claimed in claim 16 or 17, **characterized in that** the gas supply tube (3, 10) is arranged approximately centrally with reference to the cross-sectional area of the reactor (1).

19. The plant as claimed in claim 18, **characterized in that** a solids separator, in particular a cyclone (23), is provided downstream of the second reactor (9), for the separation of solids, and that the solids separator has a solids conduit (24) leading to the annular fluidized bed (35, 36) of the first and/or second reactor (1, 9).

20. The plant as claimed in claim 18 or 19, **characterized in that** a cooling device, in particular a waste-heat boiler (21) provided with banks of cooling tubes (20), is provided downstream of the second reactor (9).

21. The plant as claimed in any of claims 18 to 20, **characterized in that** temperature-control elements (15, 16), in particular a natural circulation boiler with cooling elements and membrane walls (17, 18), are provided in the first and/or second reactor (1, 9).

22. The plant as claimed in any of claims 18 to 21, **characterized in that** a gas distributor (5, 12) which divides the annular chamber into an upper fluidized bed region and a lower gas distributor chamber (4, 11) is provided in the first and/or second reactor (1, 9), and that the gas distributor chamber (4, 11) is connected to a supply conduit (6, 13) for fluidizing gas.

23. The plant as claimed in any of claims 19 to 22, **characterized in that** the first and/or second reactor (1, 9) has a supply conduit which leads to the annular chamber and is connected to an exhaust-gas conduit of the separator (23) provided downstream of the second reactor (9).

24. The plant as claimed in any of claims 19 to 23, **characterized in that** a dedusting device (31, 32) and/or a plant (33) for producing sulfuric acid is provided downstream of the separator (23).